The Likelihood of Human Casualty in Highway Crashes

5th Briefing: Incidence & Prediction of Compelling Injuries

Based on an Investigation Conducted for
the FHWA/NHTSA Crash Analysis Center
at George Washington University, Virginia

June 4, 1996
DeBlois Associates
Washington, D.C.

"The Likelihood of Casualty in Highway Crashes"

Introduction

This is the fifth briefing concerning the cited subject. Work reported here addresses and evaluates: (a) a class of injuries of interest to emergency physicians; (b) the incidence of such injuries in car crashes; (c) programmable algorithms for projecting the probability of occurrence of cited injuries; and (d) illustrative results from applications of these algorithms in several cases.

"Compelling Injuries"

In the absence of a better name, we use: "Compelling Injuries" for the characterization of a class of injuries suggested by emergency physicians, e.g. by Dr. H. Champion, as deserving top emergency medical attention. A list of these injuries is presented in Table XIV below, following the coding convention of the AIS-90 protocol.

Table XIV also presents the sample count of these injuries, available in the 1993-1995 NASS/CDS years. Furthermore, this table presents the relative weighted frequency distribution of these injuries in the NASS. The totals of the sample counts and of the frequency distribution are shown at the bottom of this table.

Raw Data

By reason of availability of OIC data for assembling the class of the so called "Compelling Injuries", the data compiled in the three years, 1993-1995, of NASS/CDS are the basic data used in this briefing. The NASS weights are used as weighing factors in any data processing procedure. As per suggestion of the NCSA Math Analysis Division, a "weight trimming" is applied in order to eliminate observations with a suspiciously high weight. Specifically, observations with a weight exceeding the 98th percentile weight are excluded from consideration.

Incidence of "Compelling Injuries" in Car Crashes

In order to evaluate the incidence of "Compelling Injuries", we define three additional classes as follows:

Other than Compelling, at AIS 3 to 6;
Other than Compelling, at AIS=2; and
Other than Compelling, at AIS=1.

Under this classification the incidence of injuries (weighted U.S. total of about 2,250,000 per year) in towaway car crashes is:

Injury Class	1993-1995 NASS Sample	Weighted % Nationally
Compelling	4,444	2.3
Other, AIS 3-6	2,551	2.0
Other, AIS=2	7,798	7.5
Other, AIS=1	42,410	88.2
All Injuries	57,203	100.0

Summary Profiles of "Compelling Injuries"

The relatively small percentage, i.e. 2.3%, of compelling injuries, with respect to all injuries, is the case for all towaway car crashes. This percentage grows much larger, as subsets of crashes under more severe conditions are addressed. This is quantitatively illustrated in Fig. 46.

"Compelling Injuries" encompass all severities, save AIS=1, as illustrated in Fig. 47. They also encompass most body regions as shown in Fig. 48. The specific body-region/AIS composition of compelling injuries is shown in Fig. 49.

Development of Algorithms for "Compelling Injuries"

The algorithms developed for this briefing address the prediction of probability for occurrence of "compelling injury" to car occupants in towaway crashes . Algorithms were developed for:

(a) Planar Crashes as a Function of Total Delta V, Direction of Force, Occupant Age, and Restraint Use; and
(b) Rollover: No or Yes, by Number of Quarter Turns, Occupant Age and Restraint Use.

Other readily available predictors such as: occupant seating position, car size, and occupant gender were found to have an insignificant influence.

Presentation of Programmable Algorithms and Applications

Fully detailed algorithms are presented below, for planar crashes, and for rollovers. Illustrative results are tabulated in Tables XV to XVIII for planar crashes, and in Table XIX for rollovers. Results are also illustrated in several figures, Figs 50 to 55.

Programmable Algorithm for Planar Car Crashes

Probability of Occurrence of "Compelling Injury" to Car Occupants in planar crashes.

$$P = 1 / [1 + \exp(-w)]$$

Model:

$$w = A0 + A1*DVTOTAL + A2*DOFF + A3*DOFL + A4*DOFR + A5*AGE + A6*RESTR$$

DVTOTAL = Total Delta V in mph Continuously;
DOFF=1 if Direction of Force is 11 to 1 O'Clock; else DOFF=0;
DOFL=1 if Direction of Force is 8 to 10; else DOFL=0;
DOFR=1 if Direction of Force is 2 to 4; else DOFR=0;
DOFF=DOFL=DOFR=0 if Direction of Force is 5 to 7.
AGE = Occupant Age in Years Continuously;
RESTR = 1 if Occupant is Restrained; else RESTR=0.

Observations used in the analysis : 15394
Number of non-zero responses: 1046

Logistic Regression Coefficients

Predictor	A	Std Err	Probabil. of A=0
Intercept	-7.57	0.43	0.0000
DVTOTAL	0.06	0.00	0.0000
DOFF	1.12	0.33	0.0007
DOFL	2.22	0.34	0.0000
DOFR	2.23	0.41	0.0000
AGE	0.02	0.00	0.0000
RESTR	-0.43	0.17	0.0115

Covariance Matrix (7 by 7)

1.825973E-001	-1.102493E-003	-8.320861E-002	-1.125366E-001
-1.102493E-003	2.442699E-005	-3.834088E-004	4.293249E-005
-8.320861E-002	-3.834088E-004	1.089581E-001	9.465224E-002
-1.125366E-001	4.293249E-005	9.465224E-002	1.183121E-001
-7.658260E-002	-3.924444E-004	1.038244E-001	9.903987E-002
-8.792463E-004	7.090473E-006	-8.904356E-005	2.103212E-004
-1.888999E-002	-3.601731E-006	1.065721E-002	1.437718E-002

-7.658260E-002	-8.792463E-004	-1.888999E-002
-3.924444E-004	7.090473E-006	-3.601731E-006
1.038244E-001	-8.904356E-005	1.065721E-002
9.903987E-002	2.103212E-004	1.437718E-002
1.700295E-001	-5.629303E-004	2.868734E-002
-5.629303E-004	1.761570E-005	-1.675377E-004
2.868734E-002	-1.675377E-004	2.839478E-002

Programmable Algorithm for Car Rollover

Probability for Occurrence of "Compelling Injury" to Car Occupants in Rollovers

$$P = 1 / [1 + \exp(-w)]$$

Model:

$$w = A0 + A1*RO13 + A2*RO45 + A3*AGE + A4*RESTR$$

RO13 = 1 if Rollover Occurs with 1-3 Qrtr Turns; else RO13=0;
RO45 = 1 if Rollover Occurs with 4+ Qrtr Turns; else RO45=0;
RO13 = RO45 = 0 if No Rollover Occurs.
AGE = Occupant Age in Years Continuously;
RESTR = 1 if Occupant is Restrained; else RESTR=0.

Observations used in the analysis : 37490
Number of non-zero responses: 2944

Logistic Regression Coefficients

Predictor	A	Std Err	Probabil. of A=0
Intercept	-3.80	0.11	0.0000
RO13	0.57	0.24	0.0170
RO45	0.71	0.19	0.0002
AGE	0.01	0.00	0.0000
RESTR	-0.59	0.11	0.0000

Covariance Matrix (5 by 5)

1.181450E-002	-9.166906E-003	-3.772089E-003	-2.230382E-004
-9.166906E-003	5.745453E-002	2.803280E-003	4.123284E-005
-3.772089E-003	2.803280E-003	3.742555E-002	-1.131322E-006
-2.230382E-004	4.123284E-005	-1.131322E-006	6.678654E-006
-2.361772E-003	1.094866E-002	2.989601E-003	-6.534282E-005

-2.361772E-003
1.094866E-002
2.989601E-003
-6.534282E-005
1.118204E-002

Table XIV.

Identification of "Compelling Injuries" in the NASS 1993-1995, by Shown Code

#	AIS-90 Code	NASS/CDS 1993-95 Sample	NASS/CDS 1993-95 Wted %
1	113000.6	24	0.479
2	120402.5	3	0.048
3	121299.3	1	0.015
4	121602.4	3	0.053
5	121606.3	1	0.010
6	140202.5	27	0.519
7	140204.5	31	0.431
8	140206.5	1	0.039
9	140208.5	1	0.027
10	140210.5	42	0.915
11	140212.6	62	0.579
12	140216.6	1	0.027
13	140299.5	5	0.061
14	140402.3	13	0.093
15	140403.3	3	0.028
16	140410.4	6	0.487
17	140414.4	1	0.010
18	140422.5	2	0.004
19	140426.4	3	0.010
20	140430.4	2	0.050
21	140438.4	4	0.064
22	140454.3	3	0.045
23	140458.3	1	0.027
24	140466.3	75	1.043
25	140470.3	1	0.224
26	140474.4	15	0.153
27	140602.3	69	1.731
28	140604.3	29	0.579
29	140606.3	49	0.848
30	140608.4	6	0.062
31	140610.5	1	0.037
32	140612.3	20	0.244
33	140614.3	7	0.269
34	140616.4	1	0.010
35	140618.5	1	0.017
36	140620.3	40	0.429
37	140622.3	28	0.305
38	140624.4	6	0.031
39	140626.5	9	0.090
40	140628.5	31	0.240
41	140629.4	45	2.080

Table XIII. Cont'd

42	140630.4	15	0.400
43	140632.4	18	1.102
44	140634.5	6	0.030
45	140636.5	3	0.021
46	140638.4	10	0.330
47	140640.4	12	0.335
48	140642.4	6	0.054
49	140644.4	6	0.062
50	140646.5	18	0.136
51	140648.5	6	0.056
52	140650.4	45	0.582
53	140652.4	64	1.656
54	140654.5	33	0.231
55	140656.5	11	0.326
56	140660.3	15	0.164
57	140662.3	10	0.658
58	140664.4	6	0.052
59	140668.3	46	0.498
60	140670.3	18	0.438
61	140672.4	12	0.307
62	140674.5	13	0.120
63	140676.3	5	0.071
64	140678.4	85	1.407
65	140682.3	22	0.152
66	140684.3	340	4.663
67	140686.3	1	0.007
68	140688.4	67	0.634
69	140690.5	8	0.136
70	140699.3	4	0.286
71	140799.3	2	0.085
72	150206.4	110	1.659
73	150404.3	133	2.292
74	150406.4	33	0.382
75	150408.4	4	0.003
76	160204.3	7	0.505
77	160208.4	2	0.134
78	160210.4	1	0.006
79	160212.5	4	0.098
80	160214.5	28	0.377
81	160404.2	7	0.200
82	160408.3	9	1.546
83	160412.3	8	0.296
84	160416.3	2	0.046
85	160602.2	26	0.749
86	160604.3	5	0.032
87	160606.2	69	1.971
88	160608.3	9	0.167
89	160610.2	3	0.098
90	160612.3	3	0.108
91	160699.2	68	3.396

Table XIII. Cont'd

92	160802.3	37	1.684
93	160804.4	22	0.327
94	160806.3	4	0.220
95	160818.5	4	0.046
96	160820.4	30	0.582
97	160822.5	22	0.814
98	160824.5	72	1.316
99	160899.3	11	0.150
100	320806.3	3	0.078
101	340204.2	1	0.010
102	340210.4	1	0.027
103	340299.2	2	0.006
104	340610.5	1	0.078
105	420202.4	8	0.072
106	420206.4	18	0.291
107	420208.4	26	0.781
108	420210.5	57	1.017
109	420212.5	2	0.010
110	420216.5	13	0.137
111	420218.6	52	0.826
112	420299.4	2	0.077
113	420408.4	1	0.037
114	420800.5	2	0.225
115	421002.3	1	0.003
116	421004.3	2	0.041
117	421006.3	1	0.007
118	421008.4	4	0.037
119	421202.3	5	0.082
120	421206.4	1	0.008
121	421404.3	2	0.034
122	421408.4	1	0.003
123	421606.4	2	0.027
124	421802.3	3	0.017
125	421804.3	4	0.032
126	421806.4	5	0.027
127	421899.3	1	0.011
128	422008.3	1	0.042
129	440210.4	3	0.023
130	441006.4	14	0.101
131	441008.3	9	0.171
132	441010.3	6	0.063
133	441012.5	35	0.642
134	441014.6	14	0.161
135	441016.6	23	0.246
136	441200.5	2	0.049
137	441300.5	3	0.013
138	441410.4	187	2.810
139	441414.3	24	0.407
140	441418.4	1	0.015
141	441420.4	3	0.276

Table XIII. Cont'd

142	441422.5	2	0.032
143	441424.5	2	0.033
144	441434.4	2	0.066
145	441436.4	8	0.097
146	441438.5	1	0.008
147	441440.5	4	0.442
148	441450.4	24	0.246
149	441454.4	4	0.084
150	441456.5	9	0.096
151	441460.5	1	0.008
152	441602.2	53	0.834
153	441604.3	1	0.005
154	441699.2	2	0.027
155	442202.3	100	2.115
156	442204.3	7	0.185
157	442206.4	1	0.010
158	442208.4	3	0.029
159	442210.5	3	0.021
160	442604.3	3	0.029
161	442608.4	2	0.003
162	442610.5	6	0.068
163	442612.4	1	0.019
164	442614.4	1	0.213
165	450230.3	181	9.837
166	450232.4	103	2.835
167	450240.4	42	0.382
168	450242.5	39	1.049
169	450250.3	11	0.082
170	450252.4	7	0.060
171	450260.4	15	0.169
172	450262.3	9	0.427
173	450264.4	23	3.322
174	450266.5	30	0.921
175	520204.4	2	0.058
176	520206.4	2	0.163
177	520208.5	2	0.032
178	520408.5	1	0.002
179	520604.3	2	0.082
180	520802.3	1	0.015
181	521202.3	5	0.051
182	521404.3	9	0.089
183	521408.4	4	0.203
184	521499.3	3	0.245
185	521602.3	8	0.113
186	521606.4	7	0.106
187	521699.3	2	0.023
188	540226.3	2	0.022
189	540826.4	4	0.026
190	541026.5	1	0.006

Table XIII. Cont'd

191	541028.5	1	0.068
192	541224.3	7	0.089
193	541226.4	1	0.021
194	541426.4	3	0.132
195	541626.4	9	0.071
196	541628.5	5	0.200
197	541640.4	3	0.057
198	541814.3	12	0.267
199	541826.4	56	0.729
200	541828.5	19	0.867
201	542026.4	4	0.072
202	542814.3	1	0.021
203	542826.4	1	0.006
204	542832.5	2	0.021
205	543224.2	2	0.010
206	544024.2	4	0.036
207	544214.3	8	0.088
208	544226.4	39	0.344
209	544228.5	46	1.432
210	544426.4	1	0.005
211	545026.3	6	0.107
212	545246.5	1	0.015
213	630226.3	1	0.002
214	640200.3	3	0.402
215	640201.3	1	0.030
216	640202.3	1	0.024
217	640204.3	3	0.060
218	640210.4	1	0.028
219	640212.4	6	0.074
220	640214.4	2	0.029
221	640216.4	2	0.032
222	640218.4	2	0.010
223	640222.5	1	0.025
224	640224.5	2	0.033
225	640226.5	2	0.006
226	640228.5	5	0.179
227	640232.6	1	0.006
228	640248.5	2	0.027
229	640250.5	5	0.076
230	640264.5	1	0.019
231	640268.5	2	0.227
232	640269.6	2	0.033
233	640270.6	1	0.007
234	640272.6	3	0.036
235	640274.6	4	0.016
236	640276.6	10	0.155
237	640410.4	1	0.121
238	640412.4	1	0.024
239	640414.4	1	0.042
240	640422.5	2	0.180

Table XIII. Concluded

241	640426.5	1	0.021
242	640428.5	2	0.030
243	640440.5	2	0.008
244	640462.5	2	0.167
245	640464.5	2	0.014
246	640468.5	3	0.021
247	640628.5	1	0.011
248	650203.3	1	0.032
249	650204.2	18	0.713
250	650206.3	14	0.134
251	650208.2	31	0.414
252	650209.2	3	0.010
253	650210.3	2	0.024
254	650212.3	4	0.010
255	650228.3	20	0.447
256	650416.2	42	0.807
257	713000.3	3	0.036
258	715000.2	1	0.026
259	720206.2	1	0.007
260	720208.3	2	0.081
261	720406.3	2	0.081
262	720606.2	1	0.008
263	811004.4	5	0.141
264	815000.2	5	0.032
265	820608.3	2	0.007
266	850610.2	57	2.512
267	850614.2	8	0.257
268	850806.2	19	0.315
269	850814.2	1	0.009
270	851802.2	8	0.158
271	852604.3	179	4.983
272	852606.4	5	0.057
273	852800.3	43	1.214
274	894006.3	3	0.024
	Total	4406	100.000

Table XV.

Probability for Occurrence of "Compelling Injuries", as a Function of Crash Severity, Delta V in mph, in Crashes of Shown Direction of Force, for 30 Year Old Unrestrained Car Occupants

PF, EPF: Probability & Standar Error when DOF=11 to 1
PL, EPL: Probability & Standar Error when DOF=8 to 10
PR, EPR: Probability & Standar Error when DOF=2 to 4
PB, EPB: Probability & Standar Error when DOF=5 to 7

DELTAV	PF	EPF	PL	EPL	PR	EPR	PB	EPB
5	0.4	0.1	1.2	0.2	1.2	0.4	0.1	0.0
10	0.5	0.1	1.6	0.3	1.6	0.5	0.2	0.1
15	0.7	0.2	2.1	0.4	2.1	0.6	0.2	0.1
20	0.9	0.2	2.8	0.4	2.8	0.8	0.3	0.1
25	1.3	0.2	3.7	0.6	3.8	1.0	0.4	0.1
30	1.7	0.3	5.0	0.7	5.0	1.3	0.6	0.2
35	2.3	0.3	6.6	0.9	6.7	1.6	0.8	0.3
40	3.1	0.4	8.7	1.2	8.8	2.0	1.0	0.3
45	4.1	0.5	11.4	1.6	11.5	2.6	1.4	0.5
50	5.5	0.7	14.8	2.1	14.9	3.2	1.9	0.6
55	7.2	0.9	19.0	2.8	19.2	3.8	2.5	0.8
60	9.5	1.2	24.0	3.6	24.2	4.6	3.3	1.1
65	12.5	1.6	29.9	4.4	30.2	5.4	4.4	1.5
70	16.1	2.1	36.6	5.3	36.8	6.1	5.9	2.1
75	20.6	2.8	43.8	6.1	44.0	6.7	7.8	2.8
80	25.9	3.6	51.2	6.7	51.5	7.1	10.2	3.7
85	32.1	4.5	58.7	7.0	58.9	7.2	13.4	4.8
90	38.9	5.4	65.7	7.0	65.9	7.0	17.2	6.1

Table XVI.

Probability for Occurrence of "Compelling Injuries", as a Function of Crash Severity, Delta V in mph, in Crashes of Shown Direction of Force, for 30 Year Old Restrained Car Occupants

PF, EPF: Probability & Standar Error when DOF=11 to 1
PL, EPL: Probability & Standar Error when DOF=8 to 10
PR, EPR: Probability & Standar Error when DOF=2 to 4
PB, EPB: Probability & Standar Error when DOF=5 to 7

DELTAV	PF	EPF	PL	EPL	PR	EPR	PB	EPB
5	0.3	0.1	0.8	0.2	0.8	0.3	0.1	0.0
10	0.3	0.1	1.0	0.2	1.0	0.4	0.1	0.0
15	0.5	0.1	1.4	0.3	1.4	0.5	0.2	0.0
20	0.6	0.1	1.8	0.3	1.9	0.6	0.2	0.1
25	0.8	0.2	2.5	0.4	2.5	0.8	0.3	0.1
30	1.1	0.2	3.3	0.6	3.3	1.1	0.4	0.1
35	1.5	0.2	4.4	0.7	4.4	1.4	0.5	0.2
40	2.0	0.3	5.8	1.0	5.9	1.8	0.7	0.2
45	2.7	0.4	7.7	1.3	7.8	2.3	0.9	0.3
50	3.6	0.5	10.2	1.8	10.2	2.9	1.2	0.4
55	4.8	0.6	13.2	2.3	13.4	3.6	1.6	0.5
60	6.4	0.8	17.1	3.1	17.2	4.5	2.2	0.7
65	8.5	1.1	21.8	3.9	21.9	5.5	2.9	1.0
70	11.1	1.6	27.3	4.9	27.5	6.5	3.9	1.3
75	14.4	2.2	33.6	5.9	33.8	7.5	5.2	1.8
80	18.5	2.9	40.6	6.9	40.9	8.3	6.9	2.4
85	23.5	3.8	48.0	7.6	48.3	8.8	9.1	3.2
90	29.3	4.8	55.5	8.0	55.7	9.0	11.9	4.2

Table XVII.

Probability for Occurrence of "Compelling Injuries", as a Function of Crash Severity, Delta V in mph, in Crashes of Shown Direction of Force, for 75 Year Old Unrestrained Car Occupants

PF, EPF: Probability & Standar Error when DOF=11 to 1
PL, EPL: Probability & Standar Error when DOF=8 to 10
PR, EPR: Probability & Standar Error when DOF=2 to 4
PB, EPB: Probability & Standar Error when DOF=5 to 7

DELTAV	PF	EPF	PL	EPL	PR	EPR	PB	EPB
5	0.9	0.2	2.8	0.7	2.8	0.7	0.3	0.1
10	1.3	0.3	3.7	0.9	3.8	0.9	0.4	0.2
15	1.7	0.4	5.0	1.2	5.0	1.2	0.6	0.2
20	2.3	0.5	6.6	1.6	6.7	1.4	0.8	0.3
25	3.1	0.6	8.7	2.0	8.8	1.8	1.0	0.4
30	4.1	0.8	11.4	2.6	11.5	2.2	1.4	0.5
35	5.5	1.1	14.8	3.3	14.9	2.7	1.9	0.7
40	7.2	1.4	19.0	4.1	19.2	3.3	2.5	0.9
45	9.5	1.8	24.0	5.1	24.2	3.9	3.3	1.2
50	12.5	2.3	29.9	6.0	30.2	4.6	4.4	1.7
55	16.1	3.0	36.6	7.0	36.8	5.2	5.9	2.2
60	20.6	3.7	43.8	7.8	44.0	5.8	7.8	3.0
65	25.9	4.6	51.2	8.3	51.5	6.1	10.2	3.9
70	32.1	5.6	58.7	8.4	58.9	6.3	13.4	5.0
75	38.9	6.4	65.7	8.2	65.9	6.2	17.2	6.4
80	46.3	7.1	72.1	7.7	72.3	5.8	21.9	7.9
85	53.7	7.6	77.7	7.0	77.9	5.3	27.5	9.5
90	61.1	7.7	82.5	6.1	82.6	4.7	33.8	11.1

Table XVIII.

Probability for Occurrence of "Compelling Injuries", as a Function of Crash Severity, Delta V in mph, in Crashes of Shown Direction of Force, for 75 Year Old Restrained Car Occupants

PF, EPF: Probability & Standar Error when DOF=11 to 1
PL, EPL: Probability & Standar Error when DOF=8 to 10
PR, EPR: Probability & Standar Error when DOF=2 to 4
PB, EPB: Probability & Standar Error when DOF=5 to 7

DELTAV	PF	EPF	PL	EPL	PR	EPR	PB	EPB
5	0.6	0.1	1.8	0.5	1.9	0.6	0.2	0.1
10	0.8	0.2	2.5	0.6	2.5	0.7	0.3	0.1
15	1.1	0.2	3.3	0.8	3.3	0.9	0.4	0.1
20	1.5	0.3	4.4	1.0	4.4	1.2	0.5	0.2
25	2.0	0.4	5.8	1.3	5.9	1.5	0.7	0.2
30	2.7	0.5	7.7	1.7	7.8	1.9	0.9	0.3
35	3.6	0.6	10.2	2.3	10.2	2.4	1.2	0.4
40	4.8	0.8	13.2	2.9	13.4	3.0	1.6	0.5
45	6.4	1.0	17.1	3.8	17.2	3.7	2.2	0.7
50	8.5	1.4	21.8	4.7	21.9	4.5	2.9	1.0
55	11.1	1.8	27.3	5.8	27.5	5.4	3.9	1.3
60	14.4	2.4	33.6	6.8	33.8	6.2	5.2	1.8
65	18.5	3.2	40.6	7.7	40.9	6.9	6.9	2.4
70	23.5	4.1	48.0	8.4	48.3	7.5	9.1	3.3
75	29.3	5.1	55.5	8.8	55.7	7.7	11.9	4.3
80	35.9	6.0	62.7	8.8	62.9	7.6	15.4	5.5
85	43.0	6.9	69.4	8.4	69.6	7.2	19.8	7.0
90	50.5	7.6	75.4	7.7	75.6	6.6	25.0	8.6

Table XIX.

Probability for Occurrence of "Compelling Injuries", as a Function of Rollover Occurrence, by Quarter Turns, for Towaway Car Occupants of Shown Restraint Use and Age

P, SEP: Percent Probability & Standar Error;

QTURNS	RESTR	OCCAGE	P.	SEP
No R/O	Unres	15	2.5	0.2
No R/O	Unres	30	2.9	0.2
No R/O	Unres	45	3.4	0.2
No R/O	Unres	60	3.9	0.4
No R/O	Unres	75	4.5	0.5
No R/O	Restr	15	1.4	0.1
No R/O	Restr	30	1.6	0.1
No R/O	Restr	45	1.9	0.1
No R/O	Restr	60	2.2	0.2
No R/O	Restr	75	2.6	0.3
1-3 QTs	Unres	15	4.4	0.9
1-3 QTs	Unres	30	5.1	1.0
1-3 QTs	Unres	45	5.8	1.2
1-3 QTs	Unres	60	6.7	1.4
1-3 QTs	Unres	75	7.7	1.8
1-3 QTs	Restr	15	2.5	0.7
1-3 QTs	Restr	30	2.9	0.7
1-3 QTs	Restr	45	3.3	0.9
1-3 QTs	Restr	60	3.8	1.0
1-3 QTs	Restr	75	4.4	1.2
4+ QTs	Unres	15	5.0	0.9
4+ QTs	Unres	30	5.8	1.0
4+ QTs	Unres	45	6.7	1.2
4+ QTs	Unres	60	7.7	1.4
4+ QTs	Unres	75	8.8	1.7
4+ QTs	Restr	15	2.8	0.6
4+ QTs	Restr	30	3.3	0.7
4+ QTs	Restr	45	3.8	0.7
4+ QTs	Restr	60	4.4	0.9
4+ QTs	Restr	75	5.1	1.1

Fig. 46. Incidence of Car Occupant Injuries by Severity, for Crashes at Various Shown Conditions

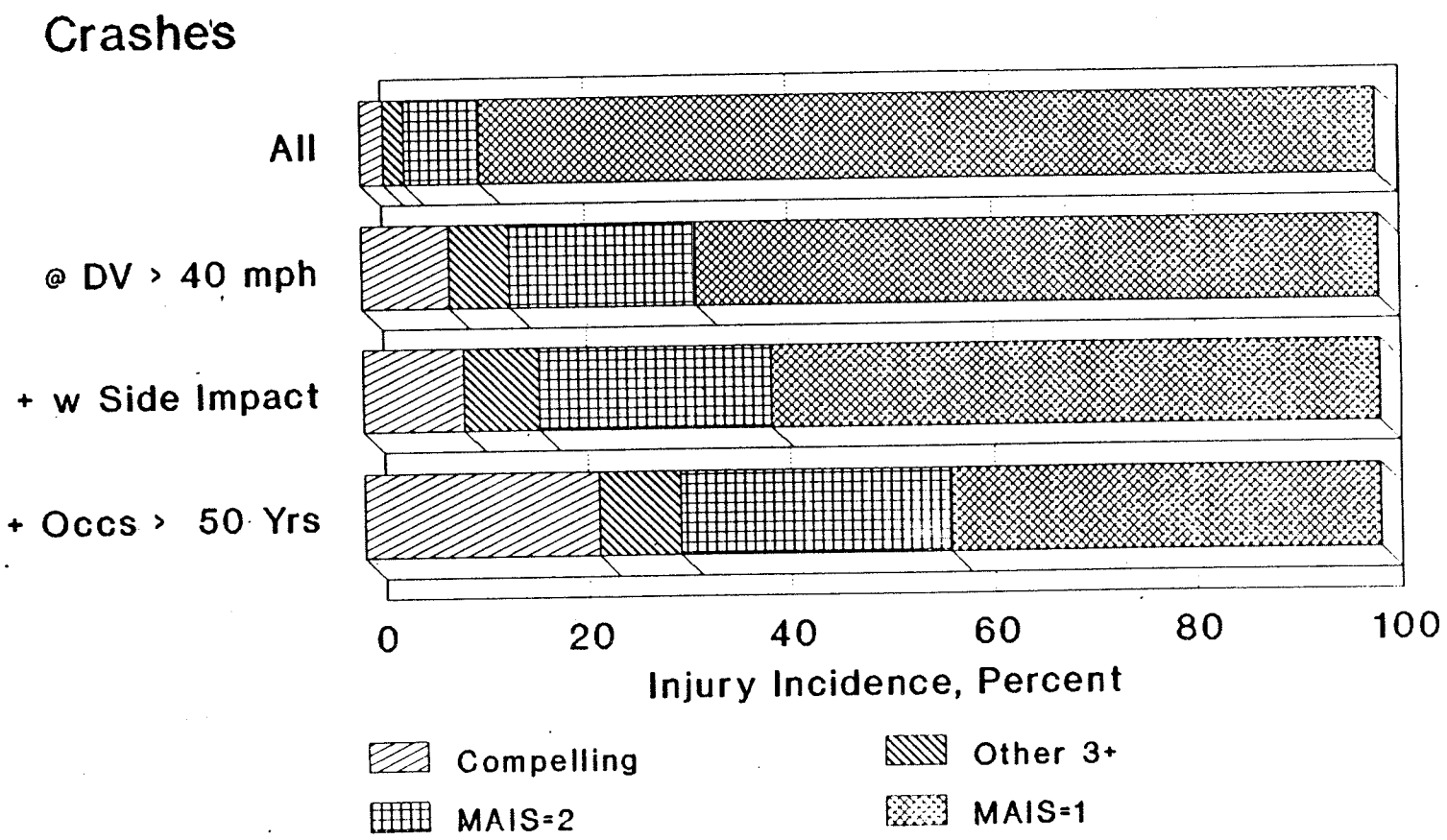

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Fig. 47. AIS Composition of the "Compelling" Class of Injuries

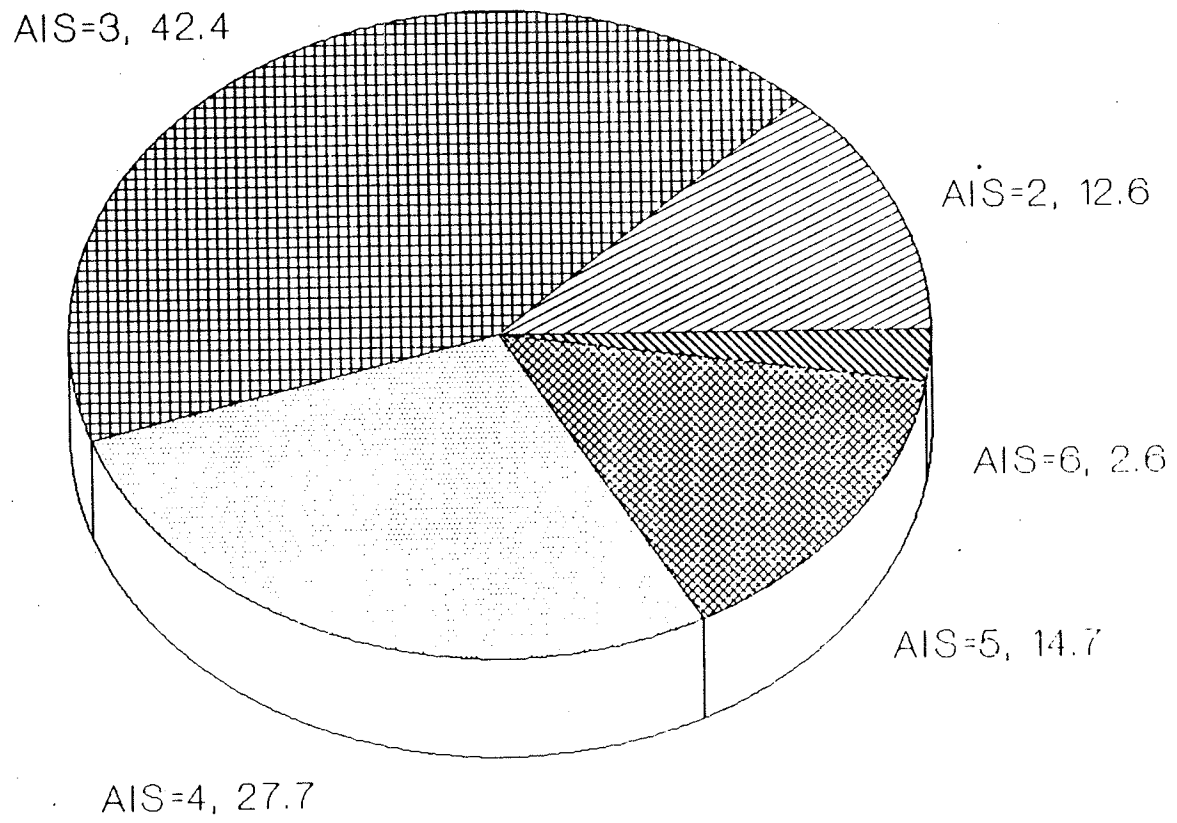

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Fig. 48. Body Regions Included in the "Compelling" Class of Injuries

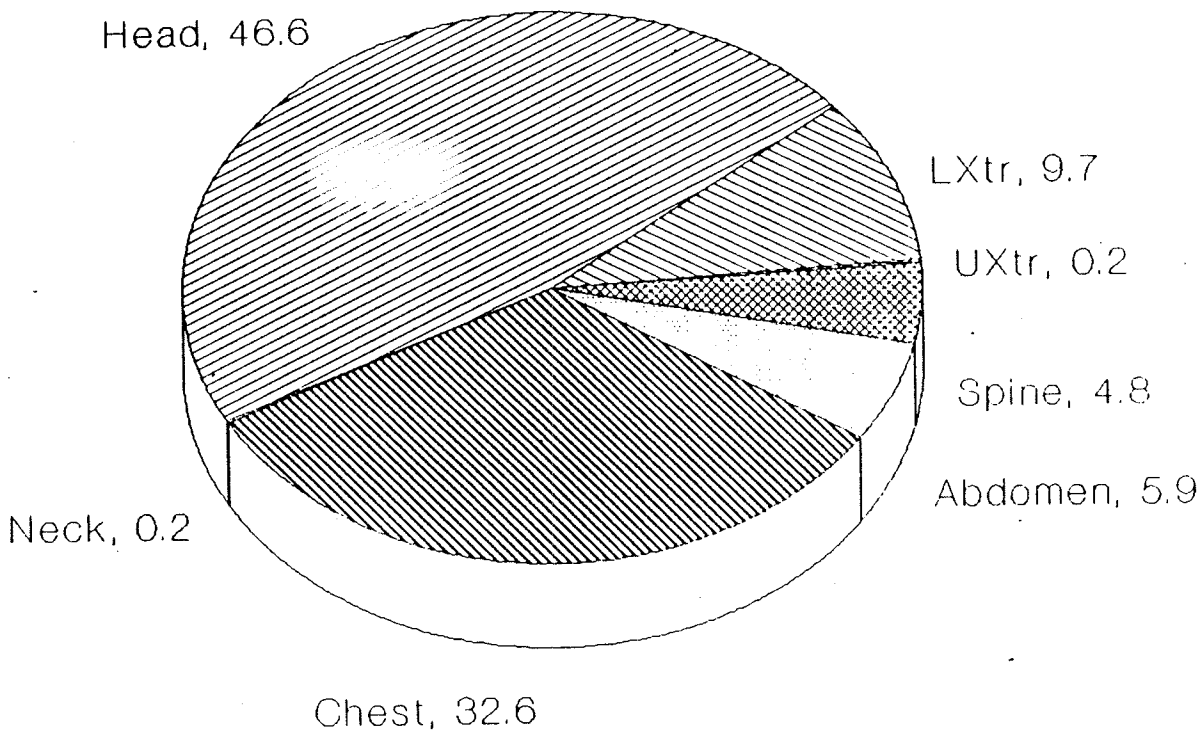

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Fig. 49. Distribution of Compelling Injuries over Injury Severities in Each Shown Body Region

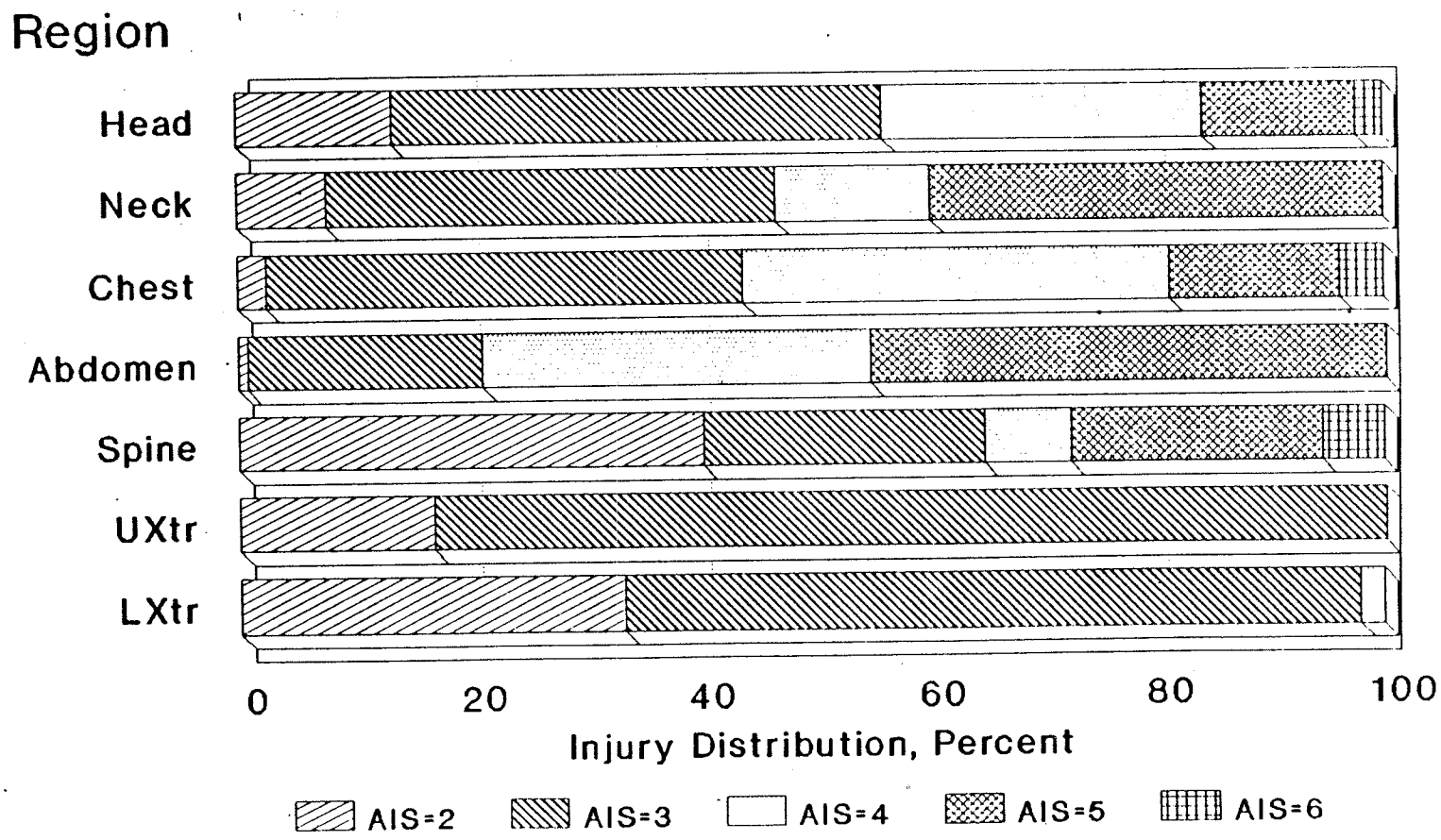

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Fig. 50. Probability of a Compelling Injury Occurrence for Shown Car Occupants in Shown Planar Crashes

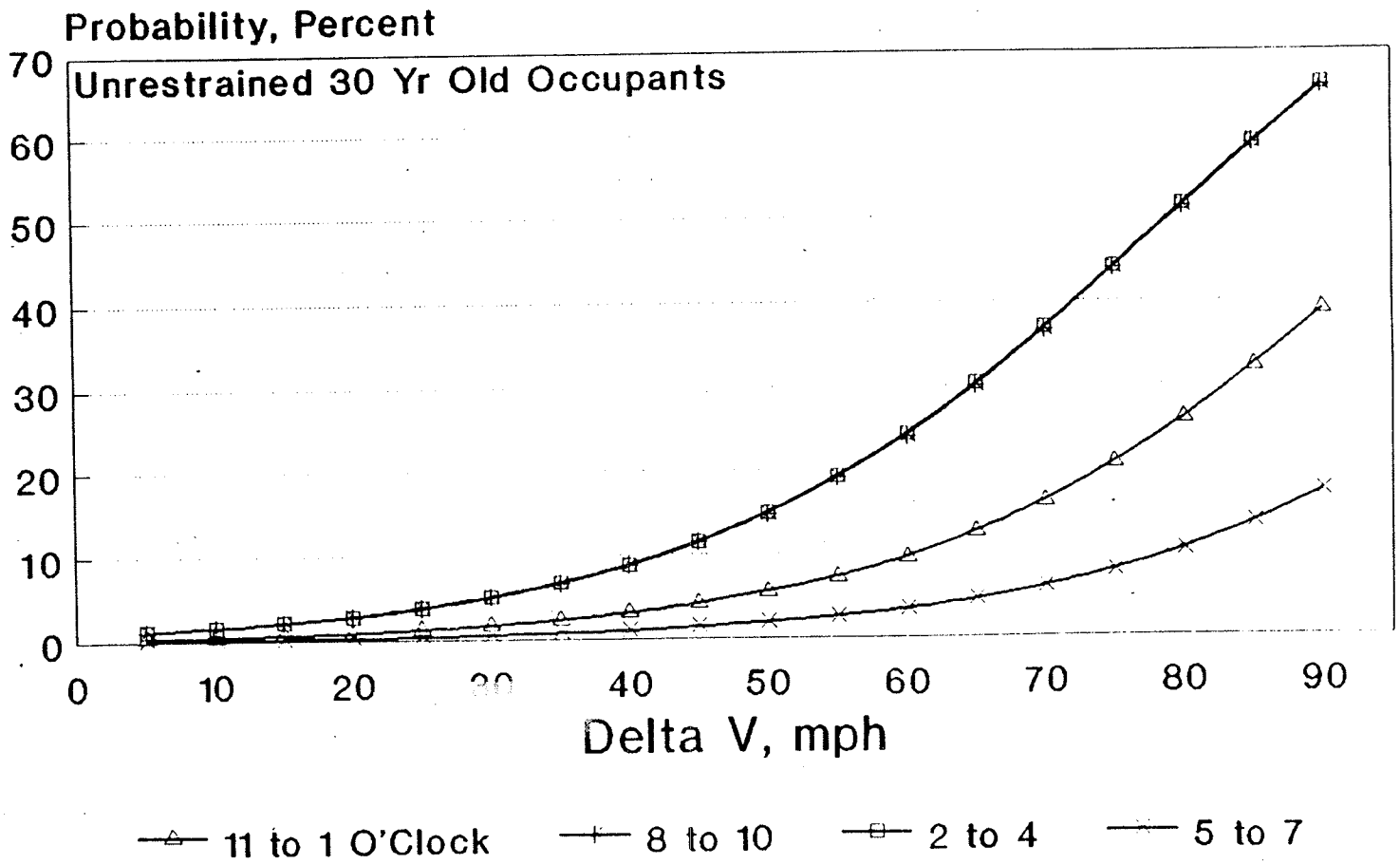

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Fig. 51. Probability of a Compelling Injury Occurrence for Shown Car Occupants in Shown Planar Crashes

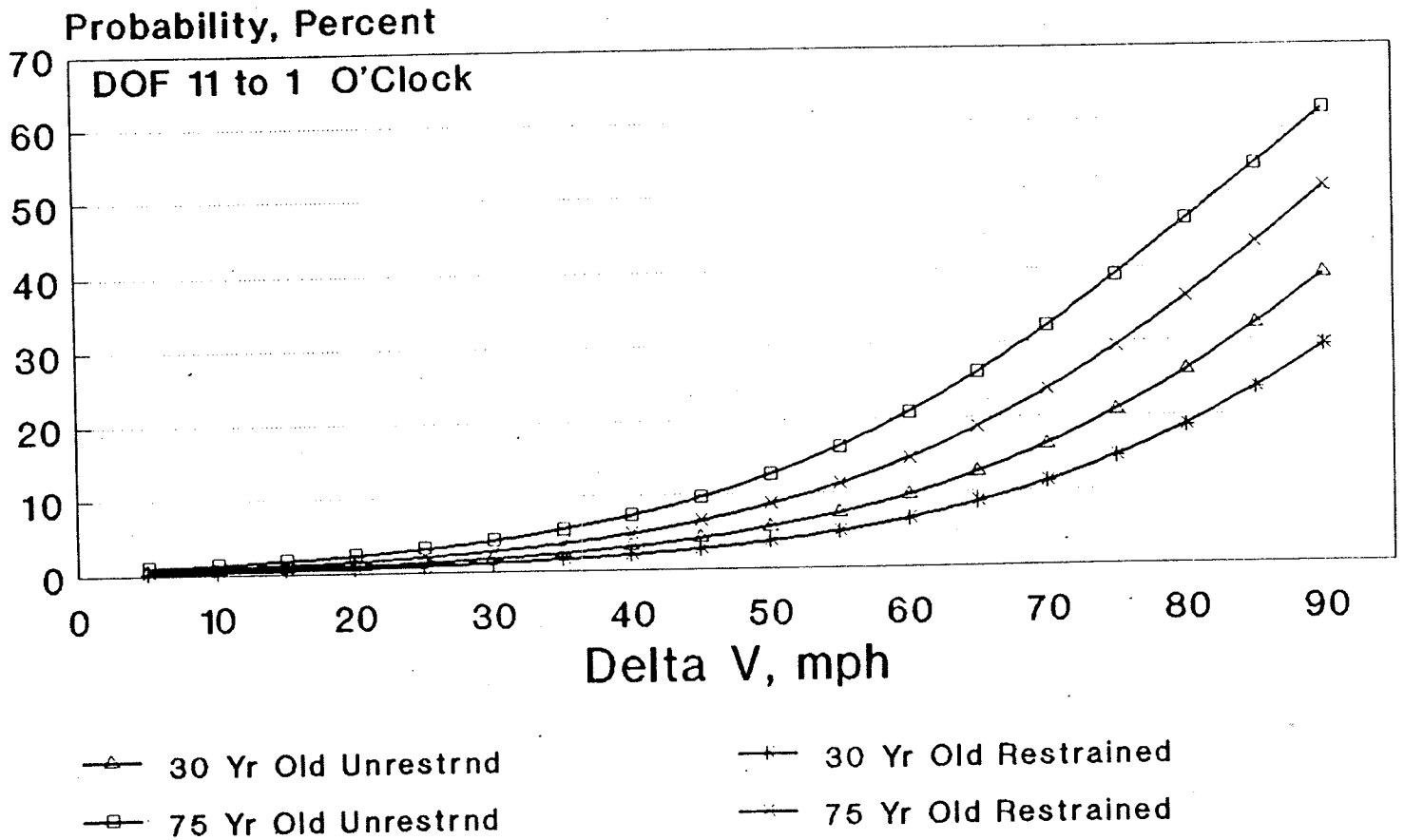

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Fig. 52 Probability of a Compelling Injury Occurrence for Shown Car Occupants in Shown Planar Crashes

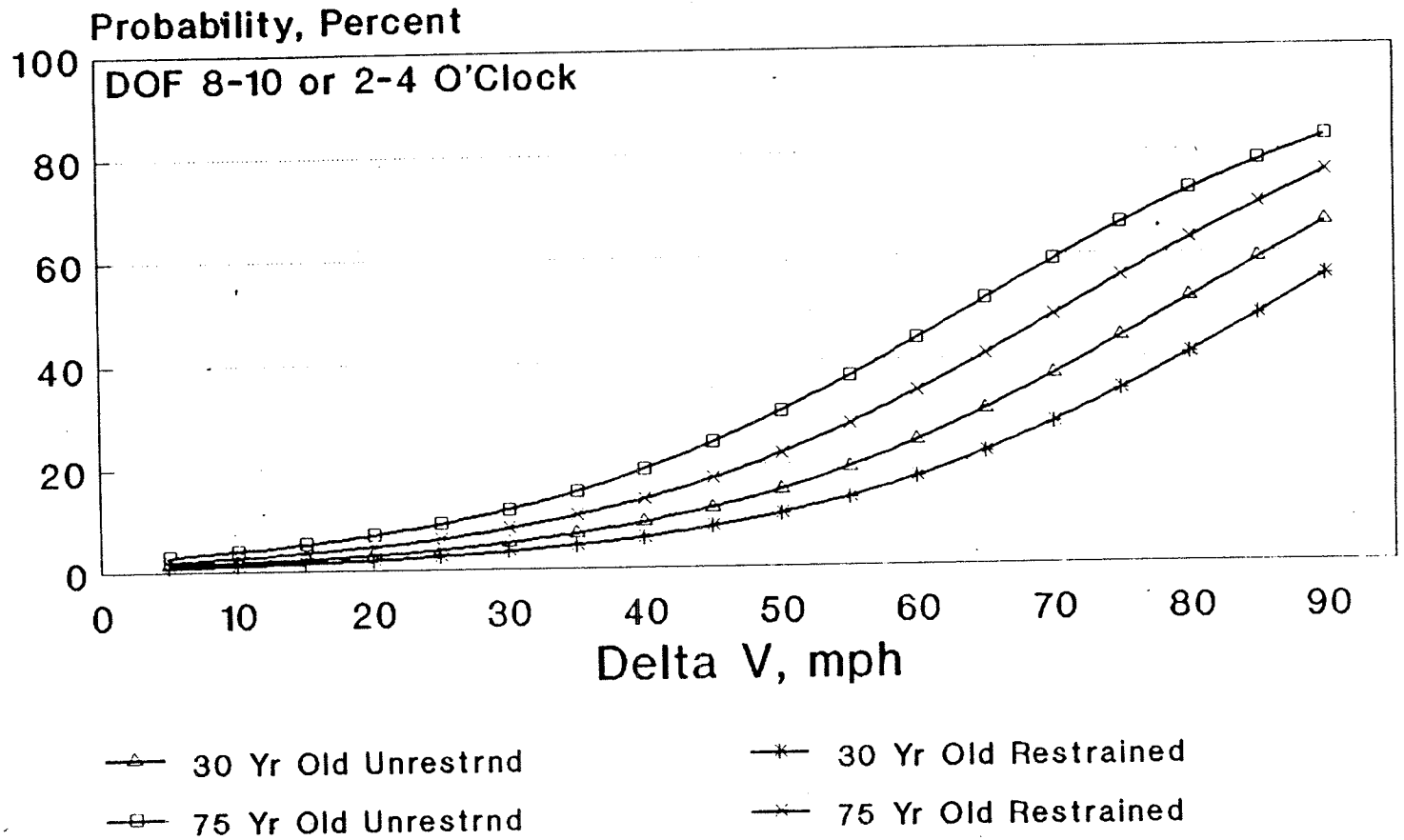

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Fig. 53. Probability of a Compelling Injury Occurrence for Shown Car Occupants in Shown Planar Crashes

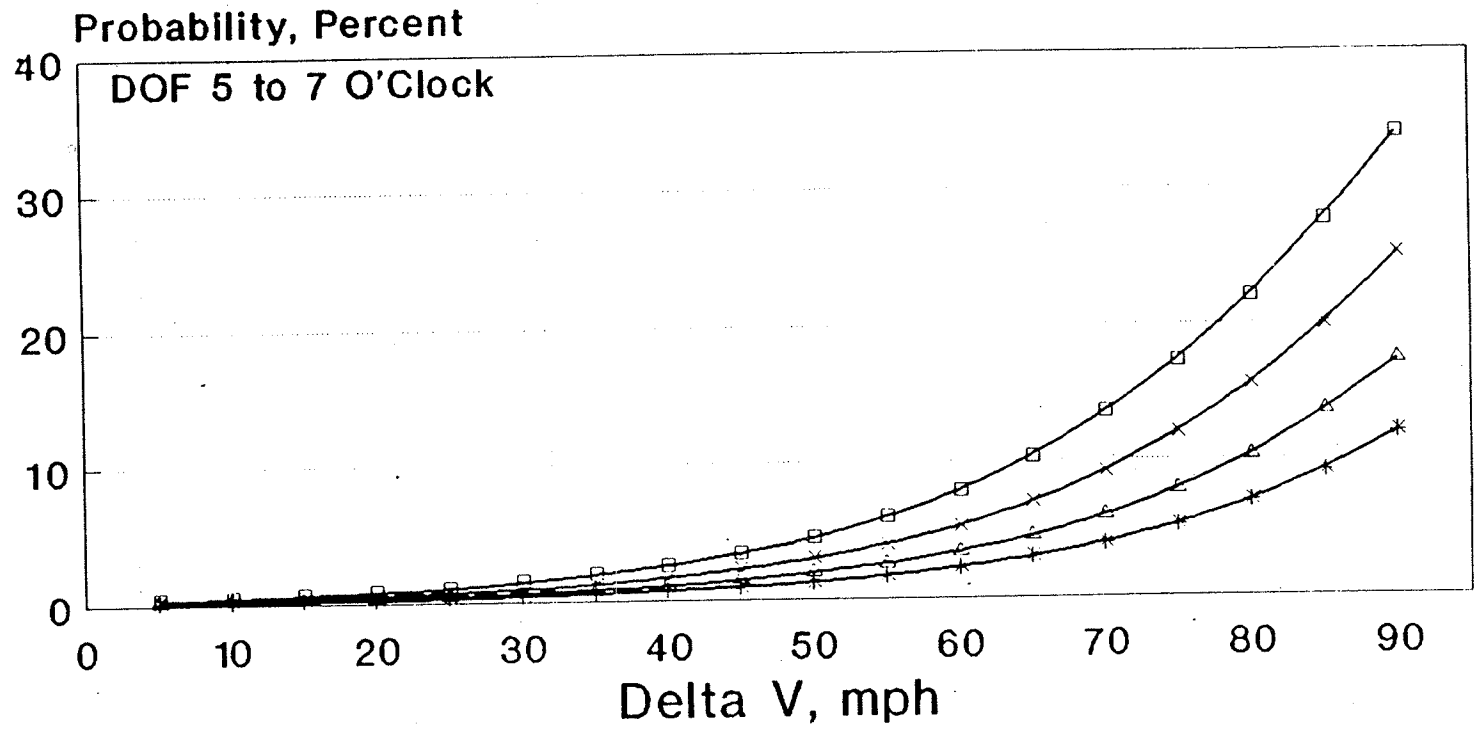

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Fig. 54. 95% Confidence Bounds of Probability for Occurrence of Compelling Injury to Occupants in Planar Crashes

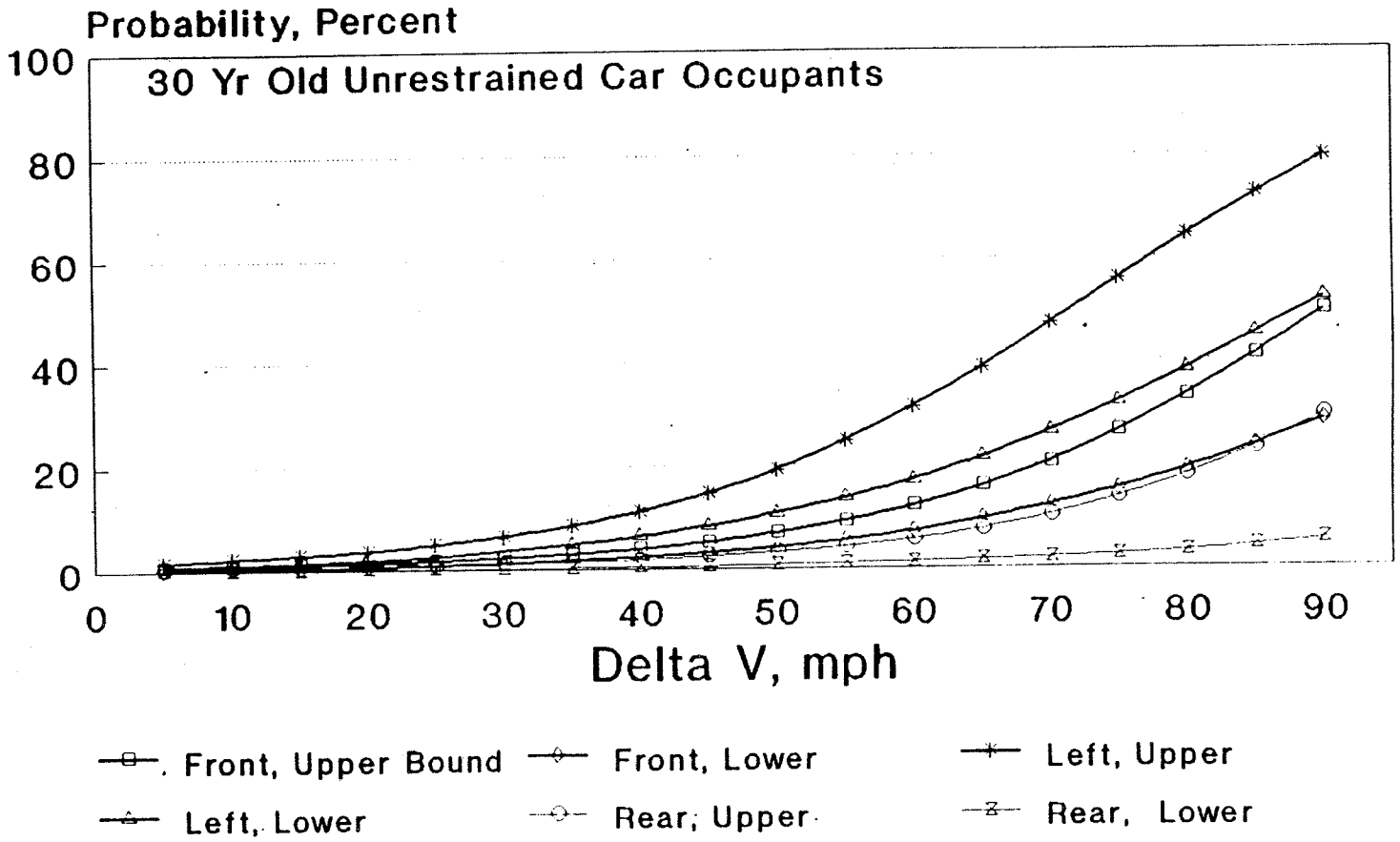

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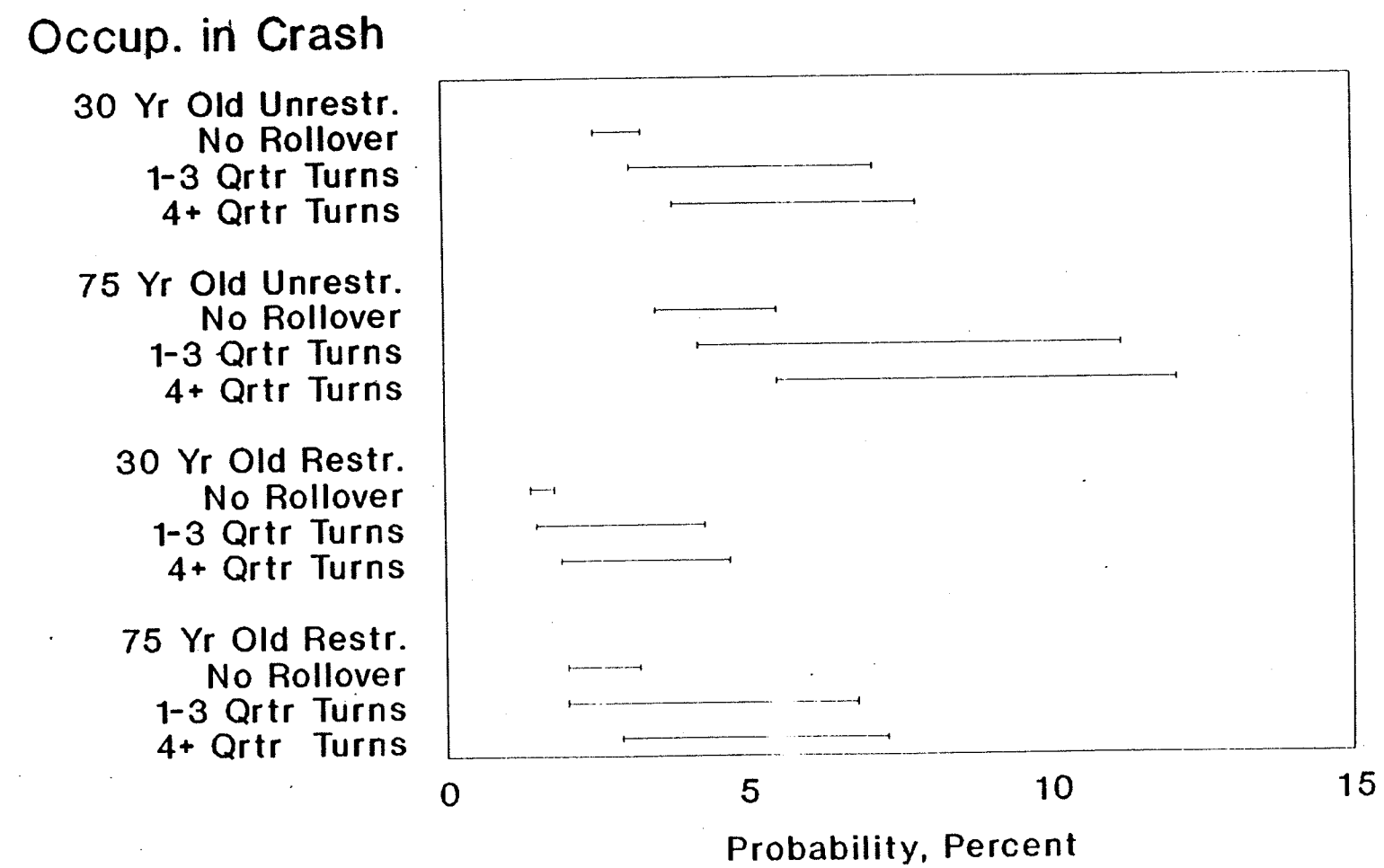
Fig. 55. 95% Confidence Bounds of Probability for Occurrence of Compelling Injury to Car Occupants in Rollovers



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